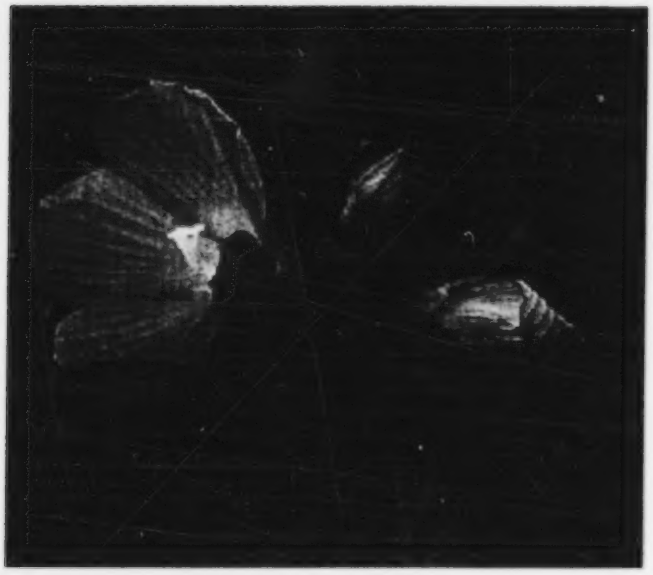
COSEWIC
Assessment and Update Status Report

on the

Swamp Rose-mallow
Hibiscus moscheutos

in Canada



SPECIAL CONCERN
2004

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA

COSEPAC
COMITÉ SUR LA SITUATION
DES ESPÈCES EN PÉRIL
AU CANADA

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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COSEWIC
Assessment Summary

Assessment Summary – November 2004

Common name
Swamp rose-mallow

Scientific name
Hibiscus moscheutos

Status
Special Concern

Reason for designation
A robust, perennial herb of shoreline marshes of the Great Lakes present in Ontario at many localities, in very small areas, and generally in low numbers. The total Canadian population is estimated to consist of fewer than 10,000 plants with some, including two of the largest populations, in protected sites. The species has been subjected historically to habitat loss and several populatins have been lost recently. Populations are also at risk from habitat degradation and impact due especially to invasive exotic plants. Evidence of the spread of plants through rafting or floating clumps indicates that recolonization of extirpated sites may be possible.

Occurrence
Ontario

Status history
Designated Special Concern in April 1987. Status re-examined and confirmed in November 2004. Last assessment based on an update status report.

COSEWIC
Executive Summary

Swamp Rose-mallow
Hibiscus moscheutos

Species Information

Hibiscus moscheutos is a robust perennial of the mallow family (Malvaceae) growing to two metres in height with up to eight showy blooms found in the axils of the upper leaves. The large hollyhock-like flowers are unmistakable, with the pink or white petals 6-10 cm long. The flowers are bisexual, and as is characteristic of all mallows, the stamens are united into a column arising from the centre of the flower. The style protrudes from the tip of the staminal column and is tipped with five round stigmas. When not in flower, the combination of tall stature, hairy, oblong or maple-like leaves, and nearly globular capsules is distinctive.

Distribution

The global range of *H. moscheutos* encompasses most of the eastern United States north of Florida and east of the Mississippi River, with a narrowing coastal distribution evident north of Maryland to Massachusetts. The Canadian range is restricted to southern Ontario, where *H. moscheutos* is confined to the coastal marshes and remnant wetlands of Lakes Erie, St. Clair, and Ontario, with only two inland stations. *Hibiscus moscheutos* appears to have expanded its range northeastward in Ontario over the last 15-20 years.

Habitat

In Canada, *H. moscheutos* is largely restricted to the Carolinian or Deciduous Forest Region. However, recent discoveries in central and eastern Lake Ontario have extended the range of the species into the Great Lakes - St. Lawrence forest region. All populations are confined to early successional wetlands that are associated with or have had a recent association with Lakes Erie, Ontario, or St. Clair. The species is most common in deep-water *Typha* marshes, where it occurs along the interface with the open water in the cattail mat; and in meadow marshes. It reaches its greatest numbers in dyked wetlands, where competition is controlled and the open habitat is maintained by periodic flooding. The importance of water-level fluctuations in maintaining marsh habitat has been well documented in the literature. Historically, populations of *Hibiscus* would have been maintained in early successional coastal habitats by natural fire, storms, and beaver activity. Various forms of human

disturbance also serve to maintain or create open conditions, well illustrated by several populations thriving in micro-wetlands along railway verges. Rose-mallow is thus tolerant of both disturbance and unstable substrates. With the low water levels of the Great Lakes over the past few years, water-level fluctuations that periodically expose and then re-flood, thus controlling *Phragmites*, shrubs, and small trees, are probably critical for the long-term suvival of this species in Canada.

Biology

Vegetative reproduction appears to be important in *Hibiscus moscheutos*, with clumps able to produce new flowering stems yearly. Clumps may also become fragmented and dispersed by wind and wave action, facilitating the colonization of new sites. In areas to the south of Ontario, most pollination is accomplished by a single species of non-social bee, *Ptilothrix bombiformis,* with much of the bee's activity centred around these plants. Other visitors to flowers noted are several species of moths, butterflies, small bees and flies, but none appear to be effective pollinators. It is important to note that *P. bombiformis* has not been reported to occur in Canada. *Hibiscus moscheutos* is found in open wetlands and is probably dependent upon periodic burning, flooding, drought, or anthropogenic disturbance to decrease shading from trees and shrubs and create open habitat.

Population Sizes and Trends

There are 51 extant stations for *Hibiscus moscheutos* in Canada, compared with 40 documented for the original status report. *Hibiscus moscheutos* varied from an infrequent component of a community, with only a few flowering stems, to the dominant species, with an estimated 10,000 flowering stems present representing an unknown number of individual plants. The total number of stems in Canada is estimated at ~25,000. Twenty populations are believed to be extirpated, based on supplementary information of field surveys conducted late in 2003.

Although many stations have been known for over 50 years, it is difficult to determine whether populations have been declining or fluctuating in numbers over this time period. This is largely due to the fact that prior to 1985, quantitative data was gathered at only three stations. In the 17 years since the 1985 field surveys and those of the update report in 2002, the number of populations seem to have remained relatively stable. Seven of the populations and four subpopulations documented in the original report are now believed extirpated, however all but two of these are small populations. Based on his field observation in 2002, the senior author believes that some of the stations are in decline as a result of competition with *Phragmites*, and to a lesser extent *Typha* X *glauca*.

Limiting Factors and Threats

Habitat quality appears to be declining at a majority of *Hibiscus* stations as a result of continuing nutrient loading, successional change, and general lack of natural disturbance. The resulting proliferation of the exotic grass *Phragmites* and the hybrid cattail, *Typha* X *glauca,* is a symptom of this degradation, as these species exploit the compromised environment. It is believed that *Phragmites* has probably resulted in the extirpation of populations or subpopulations of *Hibiscus* from six sites. *Phragmites* monocultures can replace diverse wetland vegetation and decrease plant diversity by causing alterations in nutrient cycling and hydrologic regimes. The second-most problematic invasive species impacting *Hibiscus* is hybrid cattail. It is dominant or co-dominant (invariably with *Phragmites*) at a number of the *Hibiscus* sites, and at one is believed to be effectively out-competing the *Hibiscus* over the last few years.

Existing Protection

The species is recognized as Critically Imperiled (S1) in Wisconsin, Imperiled (S2) in Rhode Island and Vulnerable (S3) in Michigan; it is not at risk in 24 other US states. It is considered as secure globally (G5) and has been accorded a national rank in Canada of Vulnerable (N3).

The major coastal marshes that support Hibiscus are quite secure, either as protected parks, private hunt clubs, or First Nation Lands that are leased out for waterfowl hunting. There is thus little chance that these marshes will be converted to other uses, and none of the major marshes have been developed since the original status report. Many are also identified as provincially significant wetlands, and are thus protected under the Provincial Policy Statement.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5th 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal agencies (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government members and the co-chairs of the species specialist and the Aboriginal Traditional Knowledge subcommittees. The Committee meets to consider status reports on candidate species.

DEFINITIONS (NOVEMBER 2004)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and it is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for atleast 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A wildlife species for which there is inadequate information to make a direct, or indirect, assessment of its risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.
** Formerly described as "Not In Any Category", or "No Designation Required."
*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994.

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Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

Update
COSEWIC Status Report

on the

Swamp Rose-mallow
Hibiscus moscheutos

in Canada

2004

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SPECIES INFORMATION

Name and classification

Scientific name:	*Hibiscus moscheutos* L.
Synonym:	*Hibiscus palustris* L.; *H. moscheutos* ssp. *palustris* (L.) R.T. Clausen
Common name:	Swamp rose-mallow
Family:	Malvaceae (mallow family)
Major plant group:	Dicot flowering plant

Hibiscus moscheutos is a taxonomically difficult species and in the past has been divided into two separate taxa, with northern plants referred to as *H. palustris* L. or *H. moscheutos* ssp. *palustris* (L.) R.T. Clausen and southern plants as *H. moscheutos* L. or *H. m.* ssp. *moscheutos* (L.) R.T. Clausen (Fernald, 1942; Clausen, 1949).

The primary characters used to separate these taxa are petal color and leaf shape. *Hibiscus palustris* L. is distinguished by its pink flowers and three-lobed leaves, while *H. moscheutos* L. is characterized by white flowers, with red centres, and lanceolate leaves. While these extreme morphologies are distinctive, populations are often found with various combinations of white and pink flowers with or without red centres and various leaf shapes. This integration is particularly pronounced in a zone extending from New Jersey to Virginia, where the ranges of the two taxa overlap (Blanchard, 1976). However, even at the edge of the range, such as in Ontario, populations can be found with variable leaf shapes and flower color. It is therefore best to recognize all these plants as *H. moscheutos* L. without further dividing this species taxonomically (Blanchard, 1976). Blanchard (1976) has also treated the midwestern species, *H. lasiocarpus* Cav., as a subspecies of *H. moscheutos* L.

Description

Hibiscus moscheutos is a robust perennial growing to two metres in height with up to eight showy blooms found in the axils of the upper leaves. The large hollyhock-like flowers are unmistakable, with the pink or white petals 6-10 cm long. The flowers are hermaphroditic, and as is characteristic of all mallows, the stamens are united into a column arising from the centre of the flower. The style protrudes from the tip of the staminal column and is tipped with five round stigmas. When not in flower, the combination of tall stature, pubescent oblong or maple-like leaves, and subglobose capsules is distinctive (see Figure 1).

It should be noted that a collection of *H. laevis* was made from Pelee Island in 1904 by H.H. York (Stuckey, 1968). This was the first and only collection of this species from Canada (Oldham, 1983). *Hibiscus laevis* is similar to *H. moscheutos* but differs in having essentially glabrous, hastiform leaves. Recent authors (Stuckey 1968; Oldham 1983) have suggested that *H. laevis* is expanding its range northward and should be looked for in southwestern Ontario.

Figure 1. *Hibiscus moscheutos* flower (photo, Bruce Ford).

DISTRIBUTION

Global Range

Hibiscus moscheutos is one of the northernmost members of the largely tropical and subtropical family Malvaceae, and is the only native, extant member of this genus occurring in Canada. The global range of *H. moscheutos* encompasses most of the eastern United States north of Florida and east of the Mississippi River, with a narrowing coastal distribution evident north of Maryland to Massachusetts. The somewhat disjunct populations in southern Ontario, northern New York, Michigan, Wisconsin, Ohio, and Illinois are centred around the lower Great Lakes (Figure 2). Since this taxon was mapped by Ford and Keddy in 1987, it has expanded its range into the US west, and is now known in California, Utah, Texas, Kansas, and Oklahoma (NatureServe 2003).

Hibiscus moscheutos is also adventive in widely separated parts of western Eurasia such as northern Portugal, southwestern France, northern Italy and western Georgia (formerly the Georgian S.S.R.). It is also known from Africa along the Algerian coast (Blanchard 1976).

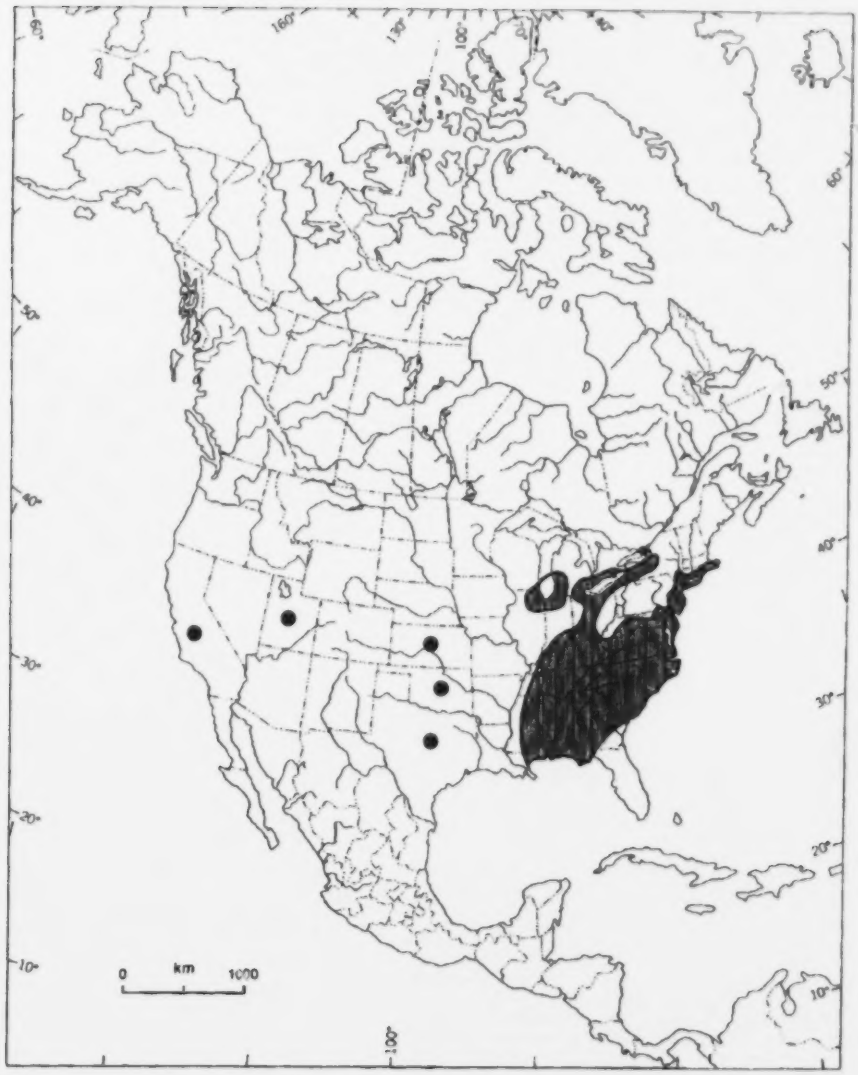

Figure 2. Global distribution of *Hibiscus moscheutos* (solid dots represent more recently identified state occurrences in NatureServe 2003).

Canadian Range

The Canadian range is restricted to southern Ontario (Figure 3), where *H. moscheutos* is confined to the coastal marshes and remnant wetlands of Lakes Erie, St. Clair, and Ontario, with a couple of inland stations (Figure 3). A total of 71 stations are known for Canada, and 51 of these are considered as extant. This species is most common in the western basin of Lake Erie, with particularly high numbers found in Essex

County (#7 & #8). Extant stations are known from the following counties/municipalities: Essex (30), Municipality of Chatham-Kent (10), Niagara RM (3), Lambton (2), Norfolk (2), Elgin (2), Prince Edward County (1), and Frontenac (1).

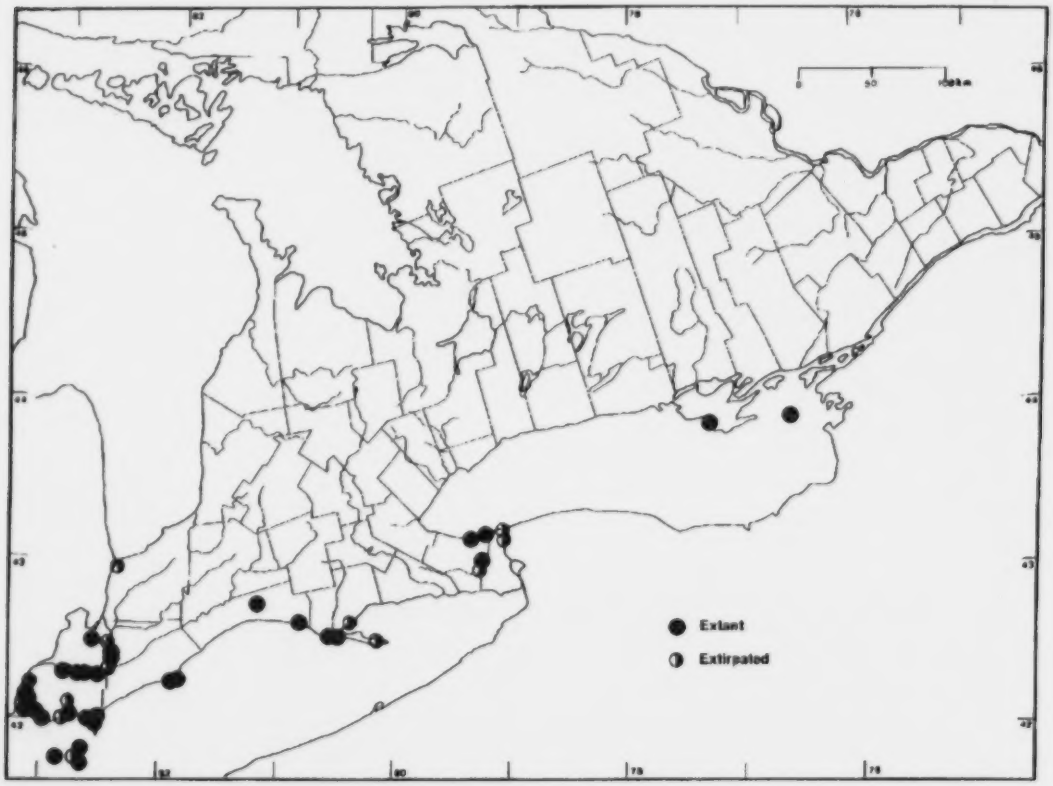

Figure 3. Canadian distribution of *Hibiscus moscheutos*.

A total of 20 stations are either known or believed to be extirpated, 10 in Essex County, four in Niagara RM, and two each in Norfolk County, Municipality of Chatham-Kent, and Lambton County. Two stations are treated as historical populations of unknown status: one at Mitchell's Bay in Lake St. Clair, the other at Long Point Biosphere Reserve. Given the distinctive nature of this species, no stations are considered as erroneous. Cultivated plants of *H. moscheutos* have been observed by the authors adjacent to homes in Belle River, Shrewsbury, Walpole Island, Amherstburg, Point Pelee NP. Although some of these were removed from natural populations, *Hibiscus* as a complex is extremely popular in the horticultural trade, and short of genetic analysis, it is probably impossible to discern native from horticultural stock.

Hibiscus moscheutos appears to have expanded its range northeastward in Ontario over the last 15-20 years. A similar phenomenon occurred in Ohio in the 1960s

(Lowden, 1969) and a parallel expansion has been noted for the closely related *H. laevis* for some time in the US (Deam, 1940; Stuckey, 1968; Utech, 1970). As explanation for this 'migration', Blanchard (1976) has suggested that, "The increased erosion and sedimentation, which accompany lumbering and farming practices, have opened up new silted-in bottomlands and sand bars to colonization by *Hibiscus*." The most notable expansion in Ontario has been on the north shore of Lake Ontario, where previously it was never recorded north of the Niagara Region. It is now known from Prince Edward County (site #51), and Frontenac County (site #52). This represents a northward extension of over 200 kms from the Niagara Region stations in the space of approximately 15 years. It is believed that this 'movement' has been achieved through ramets floating on the water from the New York populations and washing up in suitable habitat on the Ontario shoreline. Coincident with this northward expansion, the species seems to be making in-roads from its traditional shoreline habitats, and exploiting suitable habitat. Perhaps the best example being that at Kettle Creek (site #2) inland from Lake Erie. This, however, is believed to be the result of fill transported from coastal areas, rather than natural expansion.

The extent of occurrence in Canada is estimated at 22,000 km^2. The area of occupancy is about 9.5 km^2. This value is difficult to calculate for *Hibiscus*, since even though it occurs in extensive wetlands, such as at sites # 12, 26, 41, and 42, for the most part, the species is found in these marshes in a rather narrow linear band. Consequently, the entire wetland was not considered suitable habitat. Estimates for marshes at sites #26 and #42 and Rondeau, for example, were 1 km^2, for site # 41, 50 hectares, and for site # 12, 10 ha. The majority of stations (23) were less than or equal to 1 ha; 17 were between 1 and 10 ha; 6 were between 10 and 100 ha (sites # 4, 8, 9, 38, 39, 41), and 6 were estimated at 100 ha (sites # 37, 42, 44, 45, 49, and 50). The largest meadow marsh habitat for *H. moscheutos* occurs at site # 8, where it is distributed over 30 ha. The area of occupancy is believed to be in decline, for the reasons noted in the Limiting Factors and Threats section.

The distribution pattern of *H. moscheutos* has some similarities to those of members of the Atlantic coastal plain flora that have a disjunct distribution in the southern Great Lakes (Blanchard, 1976). Peattie (1922) and MacLauglin (1932) have attempted to explain this distribution pattern in relation to the post-glacial development of the Great Lakes. They postulated that extensive wetlands existed along much of the shoreline. The coastal plain flora entered the Great Lakes during the Lake Algonquin stage when there was a blockage of the St. Lawrence Valley and drainage was through the Mohawk and Hudson River valleys. It was through this avenue that plants of the coast gained access to inland marshes. It seems probable that the populations of *H. moscheutos* currently found in Ontario migrated from the east coast, following the glacial retreat, using this corridor (Blanchard, 1976). The further recession of the glaciers after the Lake Algonquin stage reduced the Great Lakes in size and obliterated the Hudson-Mohawk migration route. Historically, *H. moscheutos* was probably more extensive in its distribution than it is today. In Ontario, it is only the coastal marshes of Lakes Erie, St. Clair, and Ontario that have continued to provide the required biotic and abiotic conditions necessary for its survival.

HABITAT

Habitat Requirements

In its prime range, *Hibiscus moscheutos* occurs as a prevalent species in the oligohaline portions of estuaries, typically in low-salinity and freshwater marshes along the east coast of the United States, but also dominates marshes with highly restricted tidal regimes and often forms monospecific stands (Cahoon & Stevenson, 1986).

In Canada, *H. moscheutos* is largely restricted to the Carolinian or Deciduous Forest Region. However, recent discoveries in central and eastern Lake Ontario have extended the range of this species into the Great Lakes – St. Lawrence forest region. All populations are confined to early successional wetlands that are associated with or have had a recent association with Lakes Erie, Ontario, or St. Clair. The species is most common in two types of wetlands: in deep-water *Typha* marsh, where it occurs along the interface with the open water in the cattail mat; and meadow marsh (see Figure 4). These wetland types are dominated, respectively, at the *Hibiscus* stations, by *Typha* X *glauca* and *Phragmites australis*, unless the meadow marsh is flooded periodically. *Hibiscus moscheutos* is also found in open wet woods, thickets, spoil banks, and drainage ditches. It never spreads 'unassisted' farther than a few hundred metres from the Great Lakes or their associated wetlands, and populations recorded inland at Kingsville, St. Thomas, and Welland, are believed to have been introduced with landfill.

The importance of water-level fluctuations in maintaining marsh habitat has been well documented in the literature (e.g., Harris & Marshall, 1963; Van der Valk & Davis, 1978; Keddy & Reznicek, 1982) with drawdowns used as a standard management technique. The favourable impact of drawdowns on a Lake Erie population *of H. moscheutos* was described by Farney and Bookout (1982), who found that plants flourished during periods of low water levels. Indeed, the two most prolific populations in Ontario, at site #8 and site # 39 are both thriving in shoreline dyked marshes with frequent drawdowns and little evident competition. Historically, populations of *Hibiscus* would have been maintained in early successional coastal habitats by natural fire, storms, and beaver activity. For the past 100 years natural fire has been actively suppressed in southern Ontario, and only in the last 25 years has prescribed burning been implemented. This burning has been restricted to a few selected high priority sites, with every attention devoted to coastal marsh habitats. Beaver have been extirpated from Essex County and the Municipality of Chatham-Kent for decades. Various forms of anthropogenic disturbance also serve to maintain or create open conditions, well illustrated by several populations thriving in micro-wetlands along railway verges. Rose-mallow is thus tolerant of both disturbance and unstable substrates. Water-level fluctuations that periodically expose and then re-flood, thus controlling *Phragmites*, shrubs, and small trees, are probably critical for the long-term suvival of this species in Canada.

Apart from dyked marshes, *H. moscheutos* seems to prefer coastal marshes that are protected by a barrier beach, e.g. Point Pelee and Rondeau, rather than those

exposed to the open water, i.e. the marshes associated with the spit of Long Point. Even at Long Point, the two extant populations are both at the base of the spit, in marshes protected by barrier beach. The species does not seem to thrive in the high levels of natural disturbance experienced in marsh habitats open to the lake. Of interest in this regard, is the fact that Reznicek (pers. comm. 1985) has noted that plants on Long Point appeared to flower poorly and usually later in the season than their counterparts in Essex County.

Stuckey (1968) suggested that *Hibiscus laevis* may be adversely affected by pollution, and this certainly appears to be the case with *H. moscheutos* as well. Its prime coastal wetland habitat, nested in the agricultural and industrial fabric of southwestern Ontario, is subjected to high inputs of nutrients, herbicides, pesticides, and heavy metals.

A direct apparent impact of this degrading habitat on *Hibiscus*, has been the rise of *Phragmites*, which is exploiting the artificially high nutrients entering the system. *Phragmites* likely out-competes *Hibiscus* in this altered environment, unless periodic flooding occurs. A similar situation has likely occurred with *Typha* X *glauca*.

Figure 4. Habitat of *Hibiscus moscheutos* at Willowood East.

The soils associated with *H. moscheutos* are organic or clay, of medium texture and usually moist throughout the spring and summer. Soils have a circumneutral pH with high levels of exchangeable Ca, K, P, and Mg. In all ten study sites, concentrations of exchangeable cations decreased in the order of Ca> Mg> K> P (see Table 1 in original report). Despite the abundance of *H. moscheutos* in the coastal marshes of the

mid-Atlantic states, this plant is not a halophyte (plants of seashore or of alkaline soils). Its widespread occurrence on the Great Lakes precludes any suggestion of a dependence on salt for growth.

Narrow-leaved emergents are the most common associates of Swamp Rose-Mallow. Other than *Typha* X *glauca* and *Phragmites australis*, the most commonly associated graminoids include: *Phalaris arundinacea*, *Calamagrostis canadensis*, *Eleocharis erythropoda*, *Scirpus fluviatilis*, *Typha latifolia*, *Sparganium eurycarpum*, *Carex stricta*, and *Carex lacustris*. Frequently associated herbs are: *Polygonum amphibium*, *Impatiens capensis*, *Sagittaria latifolia*, *Calystegia sepium*, *Scutellaria galericulata*, *Iris virginica*, *Eupatorium perfoliatum*, *Lycopus americanus*, *Asclepias incarnata*, *Solidago altissima*, *Polygonum lapathifolium*, *Sium suave*, *Butomus umbellatus*, *Nuphar advena*, and *Lythrum salicaria*. *Cornus racemosa*, *Salix* spp., *Vitis riparia*, *Cephalanthus occidentalis*, and seedlings and saplings of *Populus deltoides*, were often found in and adjacent to stands of rose-mallow, and occasionally *Decodon verticillatus*.

A few of the species associated with *H. moscheutos* are considered rare in Ontario (Oldham, 1999). These are *Rosa setigera* (Ruscom Shores), *Agrimonia parviflora* (Ruscom Shores), *Nelumbo lutea* (sites # 3, 4, 37, 39), *Platanthera leucophaea* (site # 7), and *Lythrum alatum* (site # 5). *Platanthera leucophaea* has been accorded official COSEWIC status as Endangered in Canada, while *Rosa setigera* has been given official status as Special Concern in Canada. Although not directly associated with *H. moscheutos*, the vulnerable (S3) *Vernonia missurica* (sites # 7 and 21) and imperiled (S2) *Gaura biennis* (site # 7) were found nearby.

Trends

The major coastal marshes that support *Hibiscus* are quite secure, either as protected parks, e.g. sites #26, and 42; private hunt clubs, e.g. site #39; or First Nation Lands which are leased out for waterfowl hunting with substantial financial remuneration. There is thus little chance that these marshes will be converted to other uses, and none of the major marshes have been developed since the original status report. Many are also identified as provincially significant wetland, and are thus protected under the Provincial Policy Statement on Wetlands. There is a trend toward loss of the smaller wetlands, through development of subdivisions and single estate lots, and impacts associated with proximity to such housing (sites #7, 15, 25), the south shore of Lake St. Clair, e.g. at sites # 17, 19, 20; and to a lesser extent incursions by agricultural land, e.g. at site # 20.

The most noticeable trend with *Hibiscus*, is with the loss of suitable habitat through exclusion by *Phragmites*, and to a lesser extent, competition by *Typha* X *glauca*. These two invasives were not even noted as "Threats to Survival" by Ford when surveying for the original status report in 1985, but were obvious in a number of the sites surveyed by Allen in 2002. Coastal marshes on the southern shore of Lake St. Clair, at sites # 17, 19, 21, 23; on the Lake Erie Shore at Fox Creek Conservation Area (where *Hibiscus* is

now seemingly absent); along the shores of the Detroit River and the Canard River; and in the Big Creek system; are virtually solid seas of *Phragmites*, with little else other than some *Lythrum salicaria*, *Typha* X *glauca*, and young cottonwood growing there. *Typha* X *glauca* was noted as co-dominant with *Phragmites* in the Big Creek system. It is dominant along the banks of Cedar Creek; at site # 27; the stations in the St. Clair Marshes; and has been out-competing the *Hibiscus* at site # 39 over the last few years (Haggeman, pers. comm. 2002).

Protection/Ownership

Of the 51 extant stations for *Hibiscus moscheutos*, the ownership breakdown is as follows:

- 23 are privately owned by single or multiple landowners;
- 14 are publicly owned by government conservation organizations, either as 6 provincial parks (sites # 1, 51, 31, 33, and 42); 5 Conservation Authority properties (sites # 4, 7, 21, 23, and 28); 2 National Park (sites 26 and 32); or 2 National Wildlife Area managed by the Canadian Wildlife Service (sites 37 and 49).
- 5 are publicly owned by municipalities, one of which is managed as an urban park, with the other five on right-of-ways.
- 4 are owned by Canadian National Railways, and exist along the right-of-ways.
- 2 are owned by First Nations, both by Walpole First Nation.
- 1 is owned by the provincial Ministry of Transportation (site # 46).
- 1 is split between public and private ownership (site # 10).
- 1 is unknown ownership (Duck Island).

Most populations of *Hibiscus moscheutos* occur on private land and in ditches on railway rights-of-way. These include the largest populations in the province (sites # 8 and 39), and substantial ones, such as at sites #20 and 12. However, large populations also occur on land owned by the federal government (sites # 26, 37, and 49), the provincial government (sites # 31 and 42) and the Essex Region Conservation Authority (site # 4, and portions of sites # 12 and 49). A total of eleven stations are known to occur in dyked marshes, four of which are publicly owned (sites # 4, 37, 49, and 50). Active protection or management specifically directed towards *H. moscheutos* is not known to occur on any private land.

A number of the stations are recognized as provincially significant wetlands, including several of the private sites (sites # 3, 8, 12, 15, 38, 39), and all of the Big Creek populations (sites # 27, 30, 41). As such, these stations are to be afforded protection as Category 1 within the Provincial Policy Statement for Ontario (PPS). The PPS states that, "Development and site alteration will not be permitted in significant wetlands south and east of the Canadian Shield." (Ontario Government, 1997). As required by the Planning Act, local planning authorities "shall have regard to" policy statements issued under the Act. Providing that the private lands supporting the

Hibiscus populations do not have planning approvals prior to 1993, these sites should not be developed. The populations along the railway rights-of-way would likely not be classified as provincially significant wetland.

Of the 20 stations believed to be extirpated, 11 are private, 7 are public, 1 is First Nation, and 1 of unknown ownership. Of the seven public sites, one is a provincial park (Lighthouse Point Nature Reserve on Pelee Island), one is a National Wildlife Area (Long Point), one is a conservation authority property (Fox Creek), one is an urban park (Mitchell's Bay), and three are municipally owned (Kingsville Sewage Lagoon, West Dock at Pelee Island, and the right-of-way 5.3 km east of Oxley in the Town of Essex).

BIOLOGY

General

Vegetative reproduction appears to be important in *Hibiscus moscheutos*, with clumps able to produce new flowering stems yearly. Clumps may also become fragmented and dispersed by wind and wave action, facilitating the colonization of new sites. Most pollination is accomplished by a single species of non-social bee, *Ptilothrix bombiformis,* and the appearance and disappearance of adults is largely coincidental with the flowering of *H. moscheutos*, with much of the bee's activity centres around these plants (Blanchard, 1976). Other visitors to flowers noted are several species of moths, butterflies, small bees and flies, but none appear to be effective pollinators. It is important to note that *P. bombiformis* has not been reported to occur in Canada. It may be that at the edge its range, pollinators such as *P. bombiformis* are not present. Two beetles, *Althaeus hibisci* and *Conotrachelus fissunguis* are known to parasitize *Hibiscus* seeds (Blanchard, 1976).

The seeds of *H. moscheutos* can float for an extended period of time, and since plants occur in coastal marshes, seeds could be carried for some distance by water currents, particularly on high storm tides. The seeds are known to be eaten by Northern Bobwhite (*Colinus virginianus*), Blue-winged Teal (*Anas discors*), Northern Pintail (*Anas acuta*) and Wood Ducks (*Aix sponsa*) and have limited food value for waterfowl (Blanchard, 1976). *Hibiscus moscheutos* is found in open wetlands and is probably dependent upon periodic burning, flooding, drought, or anthropogenic disturbance to decrease shading from trees and shrubs and create open habitat.

Reproduction

At the time of the original status report, little was known about the reproductive biology of *H. moscheutos*. However, this has been remedied by a number of recent studies including those by Spira (1989), Snow and Spira (1991a), Snow and Spira (1991b), Spira *et al.* (1992), Snow and Spira (1993), Snow and Spira (1996), Snow *et al.* (1996), Spira *et al.* (1996), and Snow *et al.* (2000).

Populations of *Hibiscus moscheutos* consist of ramets (vegetative stems with the potential for independent existence), and genets (a plant that originates from a seed). Genets can be propagated vegetatively, but they are not clonal under natural conditions (Snow *et al.* 2000). Individual plants (genets) produce multiple shoots from a dense, fibrous, perennial rootstock. These 'clumps' are 1-2 metres in diameter (no lateral spreading), with a few to 70 flowering stems per clump, 1 to 2 m tall, and at peak flowering, up to 20 or more flowers can be open at once on the largest plants (Ford, 1985; Spira, 1989; Snow *et al.*, 1996). Vegetative reproduction appears to be important, with clumps able to produce new flowering stems yearly. Clumps may also become fragmented and dispersed by wind and wave action, facilitating the colonization of new sites.

Hibiscus moscheutos has chasmogamous flowers with a breeding system that tends to favour outcrossing (Blanchard, 1976) (Chasmogamy is the production of flowers that open to expose the reproductive organs. This allows cross pollination but does not preclude self pollination). However, *H. moscheutos* is clearly self-compatible, and seeds can be sired by inbreeding (Spira, 1989). Automatic self-pollination is prevented by the stigmas protruding well beyond the uppermost anthers. Wind pollination is unlikely as the pollen grains are sticky and tend to clump together. Flowers covered by Spira with a single layer of cheesecloth (porous to pollen but not to insect pollinators) accumulated few to no pollen grains on stigmas and failed to mature fruits, indicating that flowers were not apomictic and that a vector other than wind was needed for successful pollination (Spira, 1989). Spira (1989) concluded that, "Spatial separation of anthers from stigmas (herkogamy) effectively prevents self-pollination in this self-compatible species. It does not, however, prevent pollination between flowers on the same plant (geitonogamy). Even though *Hibiscus* clones are multi-stemmed, the number of open flowers each day is generally less than five. Most stems do not produce an open flower on a given day and those that do tend to have only one or two open flowers. The relatively small number of open flowers per genet at a given time should decrease geitonogamous pollination and promote outcrossing in this species." Snow *et al.* (1996) concluded that geitonogamy can lead to higher selfing rates.

The frequent visits to the showy flowers result in strong competition among pollen tubes for ovules (Snow *et al.*, 1996). Snow and Spira (1993) concluded from their studies on relative pollen tube growth rates that the outcome of competition between pollen tubes from self and outcrossed individuals is variable, and that pollen tube competition does not appear to be a general mechanism for enhancing the proportion of progeny that results from outcrossing in *H. moscheutos*.

In *H. moscheutos*, the effective pollinators are solitary anthophorid bees (*Ptilothrix bombiformis*) and bumblebees (*Bombus* spp.) (Blanchard, 1976; Spira, 1989; Snow and Spira, 1993). Unlike many members of the Malvaceae, flowers are held with their axis of symmetry more or less horizontal. In large flowers, this orientation is able to restrict the available landing surfaces to the reproductive parts. In *H. moscheutos*, the style branches are upturned and the stigmas are large and flattened. This combination of features provides an especially attractive landing place for insects.

According to Blanchard (1976) and Spira (1989) most pollination in their studies of US populations is accomplished by a single species of non-social bee, *Ptilothrix bombiformis*, (family *Apidae*). The appearance and disappearance of adults is largely coincidental with the flowering of *H. moscheutos* and much of the bee's activity centres around these plants. Apparently the only pollen used by this bee comes from several species of *Hibiscus*. When visiting a flower, the bee lands on the upturned stigmas and then proceeds towards the base of the flower by wading through the numerous pollen-laden anthers. Departure from the flower is usually from the lower petals so that the stigmas are not touched again. The females are the primary pollen collectors, pollen being used for provisioning the nest. As the females forage for pollen, their ventral surfaces generally become covered with it. As well, bees foraging for nectar frequently crawl over the anthers to reach the nectaries at the base of the flower, and thus accumulate large amounts of pollen on their ventral surfaces. The males, on the other hand, may drink nectar but do not collect pollen. Most of their time is spent in searching flowers for females. At night and during inclement weather, males may be found sleeping within the flower, curled around the base of the staminal column (Blanchard, 1976; Spira, 1989; Spira *et al.*, 1992).

Spira (1989) and Spira *et al.* (1992) concluded that most visits by *P. bombiformis* and *Bombus* did not result in pollination, as the visitor failed to make contact with any of the flower's stigmas. In their studies only 27% of flower-foraging *P. bombiformis* and *B. pennsylvanicus* appeared to contact a stigma while foraging for nectar or pollen. However, when they did contact the stigma, they generally deposited large amounts of pollen on the stigmas (up to 889 grains), 14 times as many pollen grains as there were ovules in the ovaries.

The two pollinator species, *Bombus* and *Ptilothrix*, use petals as a cue to locate *Hibiscus* flowers, because flowers with 100% petal removal are almost completely ignored (Kudoh and Whigham, 1998).

Other visitors to flowers noted are several species of moths, butterflies, small bees and flies, but none appear to be effective pollinators (Spira, 1989; Spira *et al.*, 1992).

It is important to note that *P. bombiformis* has not been reported to occur in Canada (Mitchell, 1962) and was not seen during this study. *Apis mellifera* and *Bombus* spp. were the only insects found visiting flowers during fieldwork for the 1985 report, however, pollinator activity was low at all stations visited. The dearth of pollinators seen during this study may simply be the result of investigation at times not conducive to insect activity. Alternatively, it may be that at the edge its range, pollinators such as *P. bombiformis* are not present.

Spira *et al.* (1992) concluded that seed production in *H. moscheutos* is clearly not pollen-limited. Between 65 and 97% of the flowers sampled in their study had excess pollen on their stigmas within 2 and 3 hours after exposure to pollinators, suggesting that pollen competition occurs frequently.

Seed Biology

The fruit is a capsule that dehisces in late fall, yielding round, hard-coated seeds <3 mm. (Cahoon and Stevenson, 1986).

Seed set appeared to be high in many of the herbarium specimens examined during the original study, but the percentage of mature capsules produced in a population and the number of viable seeds found in a capsule are not known.

Schull and Tachibara (as cited in Blanchard, 1976) have shown that a high concentration of H_2 SO is required to bring about a high percentage of seed germination.

From their studies of *H. moscheutos* in Chesapeake Bay, Kudoh and Whigham (2001) concluded that fruit maturation takes 3 to 4 weeks, and most seeds are released from dehisced fruits in October and November. Each capsule produces approximately 120 seeds (Spira, 1989).

In their study of the seed bank of a freshwater tidal marsh in New Jersey, which included *Hibiscus moscheutos*, Leck and Graveline (1979) concluded that the lack of significance in numbers of seeds at 8 to 10 cm may support the contention that in saturated marsh soils dormancy is prolonged and longevity increased. Hall *et al.* (as cited in Blanchard, 1976) observed that the seeds of *H. laevis* remain dormant while submerged in an experimental pool, but when it was drained, they germinated rapidly and profusely. This adaptation is probably an important mechanism for the colonization of mud flats and recently drained areas by *H. laevis* and other related species.

Seedling Ecology

Although *H. moscheutos* is a perennial, it is able to colonize newly created spoil banks and flower within a year of colonization.

It is presumed that as a plant matures, the root system grows and is able to produce more and more flowering stems every year. However, since large clumps can become fragmented, it is impossible to distinguish between old fragmented clumps and young plants.

Hybridization

There are numerous reports of cultivated crosses between *H. moscheutos* and other members of the genus *Hibiscus*. It is from some of these crosses that commercial cultivars are derived (Blanchard, 1976). Under cultivated conditions, crosses with *H. moscheutos* ssp. *lasiocarpos*, *H. grandiflorus*, *H. laevis*, *H. coccineus*, *H. dasycalyx* and *H. mutabilis* have been achieved with varying degrees of success. The only known naturally occurring hybrids have been with *H. grandiflorus* and *H. laevis*, but such hybrids are rare. *Hibiscus grandiflorus* has different pollinators and is largely allopatric

with *H. moscheutos*, while *H. laevis* produces semi-lethal hybrids and is separated by ecological barriers (Blanchard, 1976). Wise and Menzel (1971) noted diminished fruit and seed set in crosses between members of southern United states populations of *H. moscheutos* and *H. laevis*. Stout (1917) reported from his trials that races of *H. moscheutos* hybridized readily with *H. laevis*, giving highly fertile F1 progeny. Klips (1999) has noted that the habitats of *H. moscheutos* (open marshes) and *H. laevis* (along slow-moving river banks) sometimes merge with one another, and where plants of both species are proximal enough to allow individual pollinators to visit flowers of both species, he believes a small amount of hybridization is likely to occur. He states that hybrids should be infrequent, due to the apparent pollen competition detected in his study, but cautions that given the readiness with which a few hybrid progeny were formed under his observation, that introgression of genes from one species into the populations of the other might occur. This had not been detected between *H. moscheutos* and *H. laevis* by the time of his work in 1999.

A dwarf race of *H. moscheutos* was reported at Long Island, New York (Stout, 1917), with no plant over 26 inches tall, and all plants evidently several years old. Stout transplanted 25 of these plants to experimental plots at the New York Botanical Garden. If the results of this transplant were ever published, they could not be located by the authors.

Physiology

Spira (1989) has suggested that severe regional drought conditions can likely influence fruit set in *H. moscheutos*, and during the July and August of 1986, when plants were flowering and setting fruit, he noted symptoms of water stress such as drooping stems and wilted leaves. He found that set was extremely low in that drought year, as compared with the previous non-drought year, but that seed set within those fruits that did develop, remained quite high.

From a study site in Maryland, Snow and Spira (1996) studied the effects of salinity and high soil nutrients on pollen performance in *H. moscheutos*. They observed that their salinity and fertilization treatments resulted in reduced vegetative growth, fewer flowers, and smaller petals, as compared with the control treatment, but no change occurred in style length or paternal success following mixed-donor pollinations. The high nutrient treatment led to slightly improved growth and larger petals as compared with controls, yet this treatment also had no effect on style length or pollen competitive ability. They concluded that style length, and most importantly, the number of seeds sired, were buffered from the effects of environmental variation (they cautioned that other untested environmental conditions could influence this trait), whereas flower production and petal length were not.

Phenology

Hibiscus moscheutos is a long flowering species, blooming from July 25 to September 25, with the height of flowering being reached in the second week of August

(Botham, 1981). Up to eight blooms may be present on a stem with large clumps possessing hundreds of flowers. Single flowers arise in the axils of the upper leaves and are open only a few days before withering. In the course of development, flowers show a sequence of changes in orientation. In the bud stage they are erect, while at the time of anthesis (the period from flower opening to fruit seed set) the peduncles bend to direct the open flowers horizontally. Following anthesis, the peduncles thicken and lengthen with maturation of the fruit. Mature fruits are noticeable soon after flowering and remain on the plant. The peduncles, however, do have an abscission zone above the insertion to the leaf axil, and it is through this zone that aborted and unfertilized flowers are abscised (Blanchard, 1976).

The diurnal periodicity of *Hibiscus* has been the object of study for years. The world-renowned ornithologist Alexander F. Skutch studied *H. moscheutos* in Maryland 75 years ago (Skutch & Burwell, 1928). By mid-August, they found that most flowers unfold to practically their full extent by 7:30 or 8:00 a.m. They observed pollination, and then noted that by 4:00 p.m. the corollas had closed perceptibly, and by 6:00 they were completely closed. They found that flowers bloomed only a single day, and did not open the following morning, their period of full bloom being nine hours or less. Through their experiments, they realized a difference between the pollinated and unpollinated flowers of *Hibiscus*. If the pollination of the flowers was prevented, the flowers would remain open for two or more days. Through this work, they drew attention to the importance of considering pollination success when determining anthesis in flowers, a factor which had apparently been overlooked dating back to Linnaeus's "floral clock".

Movements/Dispersal

The seeds are known to be eaten by Northern Bobwhite, Blue-winged Teal, Pintail and Wood Ducks (Blanchard, 1976). The seeds are hard coated and may be expected to pass through the digestive tract intact (Blanchard, 1976). They have a limited food value for waterfowl (McCormick and Somes, 1982, as cited in Cahoon and Stevenson, 1986).

The seeds can float for an extended period of time, and since plants occur in coastal marshes, seeds could be carried for some distance by water currents, particularly on high storm tides (Cahoon and Stevenson, 1986). Spira (1989) has proven that the seeds are buoyant and appear to be dispersed by water. In a study of the seed bank of a freshwater tidal marsh in New Jersey, Leck and Graveline (1979) found that seedlings of *H. moscheutos* were abundant along a stream bank, suggesting effective dispersal by water (hydrochory). Kudoh and Whigham (2001) have demonstrated the importance of hydrochory to metapopulations of *Hibiscus moscheuotos* in the intertidal habitat of Chesapeake Bay. In their 1997 study, also at Chesapeake Bay, they concluded that pollinator behaviour cannot solely explain the almost complete panmixia (broad interchange of alleles) within *H. moscheutos* populations, and suggested that seeds are widely dispersed when sites are flooded. They felt that spatial mixing of genotypes by hydrochory probably reduces the effect of biparental inbreeding. Despite the evidence for gene flow between populations of *H. moscheutos,* significant genetic structuring

among populations occurs, primarily when populations are somewhat isolated from the tidal creeks (Kudoh and Whigham, 1997).

Nutrition and Interspecific Interactions

As with most flowering plants *H. moscheutos* can have a close association with its pollinators and is dependent upon them for successful sexual reproduction. However, not all insects are positively associated with rose mallow. Two beetles, *Althaeus hibisci* and *Conotrachelus fissunguis* are known to parasitize *Hibiscus* seeds. *Althaeus hibisci* can be found feeding on pollen and nectar, and gathering in the space between the corolla and calyx. Hidden in this space, the females wait for the corolla to wither, indicating that pollination has occurred. The females then begin ovipositing on the newly fertilized ovary. Upon hatching the larvae burrow through the ovary wall in the locule and then into the developing seed. The seeds appear to go through a normal development, while the larvae devour the seeds' contents. The larvae pupate in the seed and the adults emerge at the time the capsule dehisces (Blanchard, 1976). Blanchard (1976) has found high levels of parasitism in the wild and implies that infestation can become high enough to adversely affect the reproductive success of a population.

The other beetle that is found to be destructive to *H. moscheutos*' seeds is the weevil *C. fissunguis*. Apparently the adults feed on the bases of the petals and deposit their eggs within the maturing capsule. The larvae feed on the seed contents and locule wall and at dehiscence drop to the ground. The larvae pupate beneath the soil surface (Blanchard, 1976).

In a two-year study (1985, 1986) conducted on Chesapeake Bay populations of *H. moscheutos*, Spira (1989) found that approximately 53% and 89% of the potential seeds (88% were viable) within fruits were destroyed by either *A. hibisci* or *C. fissunguis*. He concluded that pre-dispersal seed predators dramatically reduced reproductive output in *H. moscheutos*. From their predator studies at a *Hibiscus* marsh in Maryland, Kudoh and Whigham (1998) concluded that final seed set varied considerably depending on the larval densities of *Althaeus hibisci* and *Conotrachelus fissunguis*. And Bauman *et al.* (2001) found from a study on the Lake Erie shore of Ohio that damage by both *A. hibisci* and *C. fissunguis* was greatest for flowers that opened before peak flowering and decreased as the season progressed. With the high levels of fruit and seed damage they observed, they hypothesized that synchronized flowering may be strongly advantageous in *H. moscheutos*, and that damage by seed predators appears to have a greater effect on plant fecundity than pollinator service, because previous studies had shown that seed production was not pollinator-limited.

Other insects known to parasitize *H. moscheutos* are the stem-boring buprestid *Paragrilus tenuis*, the stem-nesting sphecid wasp *Ectemnius paucimaculatus*, the sawfly *Atomacera decepta*, a leafroller *Chionodes hibiscella*, and the moth *Acontia delecta* (Cahoon and Stevenson, 1986; Blanchard, 1976). From their study sites in New Jersey, Weiss and Dickerson, 1919, cited in Cahoon and Stevenson, 1986), concluded that *H. moscheutos* appears to provide insect populations with a highly palatable and

diverse substrate situated above the catastrophic effects of tides and storms, and they surmised that this may account for the 30 insect species known to infest the leaves, stems, and flowers of the species. It is not known how prevalent these various parasites are in the Ontario populations of *H. moscheutos*.

Behaviour/Adaptability

Hibiscus moscheutos is found in open wetlands and is probably dependent upon periodic burning, flooding, drought, or anthropogenic disturbance to decrease shading from trees and shrubs and create open habitat. Farney and Bookout (1982) describe how high water levels in Lake Erie converted emergent vegetation into open water and virtually eliminated large common cover types, such as *H. moscheutos*. On the other hand, large areas of shallow water favoured expansion of rose mallow populations and plants did best under a management regime of controlled water levels with partial yearly drawdowns. High water levels, as well as total drawdowns, may have a detrimental effect on rose mallow populations. However, if these conditions are of a short duration they are probably beneficial in eliminating competing species and in creating open conditions.

The hardy rose-mallows were introduced into cultivation very early in the United States and Europe, with a listing of *Hibiscus moscheutos* and *H. palustris* by John Bartram and Son, Philadelphia, in 1807. From about 1850 the different species of Rose-mallows were regularly listed in European nursery catalogues, and at least one race of *H. moscheutos* has become naturalized there (Winters, 1970). Since the early 1900s, successful hybridization of *H. moscheutos* with the progeny of *H. coccineus*, *H. laevis*, and *H. grandiflorus* has produced several widely-used F1 hybrids – notably dixie belle, southern belle, and its semi-dwarf version disco belle. These hybrids are available as seed from catalogue companies, e.g. Thompson & Morgan, Chiltern, Park, Stokes, and Sakata, and are appropriate for USDA zones 5 to 10. The garden varieties bloom in 135 to 150 days from seed. They can be started in February to March in a warm greenhouse and grown in large individual pots. Soaking the seed for 24 hours prior to sowing is beneficial to germination. Germinate for 1 to 2 weeks at 21° C. The hybrid found for years in the nursery trade as Meehan's Mallow Marvels, was obtained by crossing a hardy red-flowered hybrid of *H. coccineus* X *H. militaris* with *H. moscheutos* (Wise and Menzel, 1971; Vesterin, 1997).

H. moscheutos plants withstand transplanting easily when in full flower, and are also readily grown from seed and will flower the first season if sown early (Winters, 1970).

POPULATION SIZES AND TRENDS

For this report, the term population is used to refer to the basic unit, and is defined as, "A group of individuals that reproduce with one another and produce offspring" (Primack 1993). This term, when applied to *Hibiscus moscheutos*, does not imply any

genetic isolation between populations, as the species likely experiences few barriers to genetic exchange between proximal populations in southern Ontario, other than of course, the fragmentation of its prime habitat. The term station, site, or population, is thus used interchangeably to refer to one or more subpopulations of *H. moscheutos* that are separated from other populations by at least 1 km of unoccupied or unsuitable habitat. This is the definition used by the Natural Heritage Information Centre (NHIC) for an Element Occurrence (EO), thereby facilitating comparisons with, and additions to, that dataset. All populations were plotted on topographical maps in NAD 27, using the information collected by the first author, e.g. pers. comm., and referencing these against the NHIC Element Occurrence Summaries for each population. The criteria regarding 'lumping' or 'splitting' to define a population was then applied, with those records within one km proximity treated as subpopulations.

There are 51 extant stations for *Hibiscus moscheutos* in Canada, compared with 40 documented for the original status report. *Hibiscus moscheutos* varied from an infrequent component at a station, with only a few ramets (vegetative stems with the potential for independent existence), to the dominant species, with hundreds of genets (a plant that originates from a seed) and thousands of flowering ramets present. A common root system in a dense clump of 1-2 metres in diameter can support up to 70 flowering stems, and these clumps are usually randomly distributed throughout a given habitat, and appear to persist for some time. The problem in population estimates with the species lies in the fact that it is impossible to distinguish between old fragmented clumps and young plants. As a result, most of the population estimates by various observers have focussed on the number of flowering stems, while some have noted the number of individual clumps. Crude estimates of population sizes, using stem counts, were obtained during the 2002 field surveys, and these are cited in Table 1, along with any prior quantitative observations, including in particular, Ford's 1985 surveys. Those populations believed to be extirpated are also listed with their respective population estimates, for comparative purposes.

A total of 71 stations has been recorded for Hibiscus moscheutos; 20 of which are now believed to be extirpated; two are considered as historical populations of unknown status. Of the 51 extant stations, 47 have been recorded with some level of quantification (Table 1). Of these 47 stations, 19 of these are believed to support moderate to large populations of 100 clumps or stems. The majority of sites (28 localities), consist of small populations, many with only single or few plants. Of the 19 moderate to large stations, only four (#8, 39, 26, 42) can be said to be common over an extensive area, and only at the former two does Hibiscus form a continuous cover. Population #8 has the largest number of plants, estimated at 10,000 flowering stems over approximately 30 hectares of dyked meadow marsh. The actual number of plants represented by this count of stems is unknown but likely represents >>1000 plants. Population #39 has the next highest number of stems and also consists of >>1000 plants scattered over approximately 18 hectares of dyked meadow marsh. At population #26, Hibiscus is locally common in the open marsh with hundreds of clumps along the margin of the cattail mat (Oldham pers. comm. 2002). The species is also common at population #42, with perhaps 100 clumps scattered for several kms along the open edge of the marsh (pers. comm. Dobbyn, Oldham, &

Woodliffe, 2002). Although some of the stations support high numbers of plants, the actual area of occupancy is very small. Both population #20 and #7 boast 1,000 stems each; the former exists in ditches wedged between railway tracks and roadways, while the thousands of flowering stems at #7 are packed into a section of meadow-marsh of less than one hectare.

Table 1. *Hibiscus moscheutos* Population Information for Ontario Stations.
[updated with Aug/Sept. 2003 field observations for several sites by A. Woodliffe and M. Austen].

Pop#/Site Name	Number of Plants/Flowering Stems				Observer(s) or Rationale
	<1980s	1980s	1990s	2000s	
#1	1 plant	2 plants	1 plant	0	Stewart 1964 & 68 Oldham 1989 Oldham 1999 Allen & Jean 2002 – not located
#2				1 plant	Woodliffe 2001
#3		Few plants	Many plants	0	Ford 1985 Reume 1999 Allen 2002 Different sub-pops
#4		70 stems		Local & occas.	Ford 1985 Allen & Waldron 2002
#5		No est.			Ford 1985
#6		>400 stems; scattered plants		Few plants; 30 stems	Ford 1985 Oldham 1987 Allen 2002 Different sub-pops
#7		2,000-3,000 stems		1000s of stems	Ford 1985 Allen 2002
#8		2,000-3,000 stems		10,000 stems (>>1000 plants)	Ford 1985 Allen 2002
#9		7 stems			Allen 2002
#10				scattered	Allen & Waldron 2002
#11				scattered	Allen 2002
#12		300 stems		20 stems	Ford 1985 Allen 2002 – not a full survey
#13		3 stems			Ford 1985
#14		1 clump			Oldham 1987 Could not access Allen 2002
#15		5-10 clumps		225 plants	Oldham 1987 Larson 2000
#16		1 clump		1 clump	Oldham 1985 Allen 2002
#17		Large colony		150 stems	Oldham 1985 Allen 2002 Different sub-pops
#18		1,000 stems			Ford 1985
#19		800 stems		100 stems	Ford 1985 Allen 2002
#20		Few stems		1,000 stems	Ford 1985 Allen 2002

Pop#/Site Name	Number of Plants/Flowering Stems				Observer(s) or Rationale
	<1980s	1980s	1990s	2000s	
#21		200 stems			Ford 1985
#22				No est.	Haggeman 2002
#23		1 clump			Oldham 1985
#24		1 clump			Oldham *et al.* 1988
#25		Local	Few plants	30 stems	Oldham 1988 Oldham 1990 Allen 2002
#26		Scattered		100s of clumps	Ford 1985 Oldham 2002
#27		300 stems		200-300 stems	Ford 1985 Allen 2002
#28		10 stems			Ford 2002
#29		Few; 5-10 clumps; uncommon			Oldham 1982 Oldham 1985 Oldham 1988
				none	Woodliffe, Aug. 2003
#30		1clump; 10-20 clumps			Oldham 1982 Oldham 1985
				none	Woodliffe, Aug. 2003
#31	1 colony	Few; rare	1 clump		Stuckey 1967 Oldham 1982 Oldham 1988 Oldham 1999
				29 clumps	Woodliffe Aug. 2003
#32					No estimates of #s
#33		7-8 clumps			Oldham 1988
#34		10 stems			Ford & Allen 1985
#35		1 clump			Oldham *et al.* 1985
				1 clump	Woodliffe, Aug. 2003
#36		5 stems			Ford 1985
#37		150 stems; 30 stems		140+ stems	Ford 1985 Oldham 1987 Allen *et al.* 2002
#38		300 stems		Scattered clumps	Ford 1985 Allen *et al.* 2002 different sub-pops
#39				1000s of stems (>> 1000 plants)	Allen *et al.* 2002
#40				Dozens of plants	Haggeman 2002
#41		Few stems		Scattered clumps	Ford 1985 Woodliffe 2000
				340 clumps	Woodliffe, Sept. 2003
#42				Common; 50-100 clumps; 75 clumps	Dobbyn 2002 Oldham 2002
				Likely >500 clumps	Woodliffe, Sept. 2003
#43				1 clump	Woodliffe 2002

Pop#/Site Name	Number of Plants/Flowering Stems				Observer(s) or Rationale
	<1980s	1980s	1990s	2000s	
#44		Several small pops			Allen *et al.* 1985/86
#45				1 patch running for 100 metres	Austen 2003
#46		20 clumps			Meyers early 1990s
#47		6 plants			Meyers early 1990s
#48				Large group of plants	Thompson & Smith
#49		2 plants, many stems	171 stems	500 stems	Reznicek & Catling 1981 Sutherland 1992 Allen & Jean 2002
#50		50 stems; 1 clump		3 clumps	Ford 1985 Oldham 1987 Bowles & Gorniak 2002
#51			4 plants with 14 stems	8-9 plants with 46 stems	Brownell 1998 Bree 2002
#52					No estimates of #s
#53	Few plants	Scarce			Stuckey 1969;Oldham 1983
				1 clump	Woodliffe, Aug. 2003
Fighting Island		100 stems		0	Ford 1985 Believed extirpated – Allen 2002
LaSalle Marina		40 stems		0	Ford 1985 Believed extirpated – Allen 2002
Kingsville Sewage Lagoon		Few clumps; extirpated		Extirpated	Oldham 1983 Ford 1985 Allen 2002
Fox Creek Cons. Area		1 clump		0	Believed extirpated –Allen 2002
1.5 kms S of Arner		50 stems		0	Believed extirpated –Allen 2002. A subpop of Cedar Creek station.
4.5 km E of Oxley		50 stems		0	Believed extirpated –Allen 2002
5.3 km E of Oxley		1 plant		0	Believed extirpated –Allen 2002
S of West Pump	Few plants	Scarce			Stuckey 1969 Oldham 1983
Turkey Point Marsh	No estimate		0		Norris 1943 Bowles 198? Believed extirpated
Bluff Point, Long Point		No estimate			Catling 1981 Believed extirpated
Thames River Mouth	No estimate				Stock 1956 Believed extirpated
Mitchell's Bay		1 plant			Oldham 1987 Believed extirpated

Pop#/Site Name	Number of Plants/Flowering Stems				Observer(s) or Rationale
	<1980s	1980s	1990s	2000s	
Sarnia	No estimate	0			Dearness 1894 Ford 1985 Believed extirpated
Grassy Bend Island, Walpole	No estimate				Shields 1950 Believed extirpated
Welland Canal	Few plants	0			Anderson 1952 Ford 1985 Believed extirpated
Niagara-on-the-Lake	No estimate	0			Scott 1910 Ford 1985 Believed extirpated
Queenston	No estimate	0			Scott 1899 Ford 1985 Believed extirpated
Miller Creek	Large patch				Sherk 1968 Believed extirpated

Although many stations have been known for over 50 years, it is difficult to determine whether populations have been declining or fluctuating in numbers over this time period. This is largely due to the fact that prior to 1985, quantitative data was gathered at only three stations. Compounding this situation is the lack of confidence that population estimates are applicable to the same sub-populations within a given station. In the 17 years between Ford's field surveys in 1985 and Allen's in 2002, stations seem to have remained relatively stable in their numbers. One of the main differences is that seven populations and four subpopulations documented by Ford are now believed extirpated, however all but two of these (Fighting Island and Puce) are small populations. Although not verified at this time, the senior author, based on his 2002 field observations, believes that some of the stations are in decline as a result of competition with *Phragmites*, and to a lesser extent *Typha X glauca*, e.g., the populations on the Detroit River, those at #3, #9, #12, #50, as well as those populations along the south shore of Lake St. Clair at #17, #18, #19, #16, #21.

A total of 19 stations listed in the present report as extant were either not listed at all in the original report, or were cited as Historical Populations of Unknown Status. The majority of these were not discovered until after the original report was completed, mostly in the late 1980s, but some very recently, e.g. site #51 (1998), site # 2 (2001), site # 22 (2002), and site # 40 (2002). While site # 51 almost certainly represents a new population, those at sites 22, 39, and 40 are in privately held marshes with regulated access, and could have thus escaped detection for some time. Similarly, sites # 32 and 33 are quite remote, and the populations here may have existed for several years prior to the first recorded observations in the late 1980s.

Ford listed 17 stations as "Historical populations of unknown status". Although some of these were noted as possibly extirpated, none were officially cited as such. The present report serves to clear up the uncertainly with these stations, retaining only two stations as "Historical" (Mitchell's Bay and Long Point Spit); with ten stations being moved to "Extirpated", three to "Extant", and the Pelee Island Fox Pond station being combined with Fish Point. Of the 20 stations now listed as extirpated, most are small populations, the rest were never recorded with abundance information.

About 51 extant stations have been documented comprising a total of about 25,000 flowering stems. The total number of actual plants represented by such an estimate is uncertain but likely represents thousands of plants (but < 10,000). The total area of occupancy is estimated at about 9.5 km^2, and the total extent of occurrence for the 51 stations is about 22,000 km^2.

All populations visited during 1985 and 2002 appeared vigorous and flowered successfully. However, Reznicek (pers. comm. 1985) has noted that plants on Long Point (site # 50) appeared to flower poorly and usually later in the season than their counterparts in Essex County. It would appear that if habitat requirements are maintained, populations are able to persist for a considerable period of time.

In Ontario, *Hibiscus moscheutos* is not under immediate threat for the time being. It is fairly common in Essex County, and in the Municipality of Chatham-Kent along the Lake St. Clair shoreline, and large populations of thousands of flowering stems persist, albeit primarily in the artificial conditions afforded by dyked marshes. In natural marsh habitats, its success has been challenged by the recent rise of *Phragmites australis*, and to a lesser extent *Typha* X *glauca*, and a downward trend in these non-manipulated sites seems inevitable.

Extirpated Populations

Essex County

Fighting Island, Town of LaSalle (formerly Sandwich West Township) (EO 014). Last observed in 1985 by B.A. Ford. The island was not accessed by G.M. Allen in 2002 but the island was scanned 12 August 2002 by binoculars from the same vantage point as Ford's observation, from the river's edge at the LaSalle Marina toward the northeast end of the island, but no *Hibiscus* was observed. Virtually all marsh habitat observed was occupied by *Phragmites* and the station is believed to be extirpated.

LaSalle Marina, Town of LaSalle (formerly Sandwich West Township) (EO 048). Last observed in 1985 by B.A. Ford as a "Large clump of 40 flowering stems along edge of cattails adjacent to dredged channel." This population could not be relocated in 2002 by G.M. Allen. The dock 200 metres to the south was also searched, but both shorelines are in residential development and any available marsh remnants are dominated by *Phragmites*.

Kingsville Sewage Lagoon, Town of Kingsville (formerly Gosfield South Township) (EO061). Observed by M.J. Oldham in 1983 with "A few clumps." Ford noted that by 1985 "This population appears to have been extirpated as the result of sewage pond construction." G.M. Allen again searched this site 12 August 2002. No natural wetland was observed, and the water levels were very high in the settling ponds. The pond edges, which can sometimes offer suitable wetland habitat, mostly maintained as rock gabion. Last observation 1983, no suitable habitat exists, and believed extirpated.

Fox Creek Conservation Area, Town of Essex (formerly Colchester South Township) (EO 041). Observed in 1985 by Ford with "Single plant growing in a low area adjacent to a parking lot." Not refound by Allen in 2002, and essentially all available habitat occupied by *Phragmites* on east side of road. West of the road was checked out as well, with no *Hibiscus* observed. Last observation by B.A. Ford in 1985.

Cedar Creek, 1.5 km south of Arner, Town of Kingsville (formerly Gosfield South Township) (Technically one of the subpopulations of the main Cedar Creek station). Ford observed "About 50 flowering stems growing along County Road 23 adjacent to cornfield with *Phalaris arundinacea* and *Scirpus fluviatilis*." in 1985. This population could not be located by G.M. Allen on 12 August 2002 and is believed to be extirpated.

4.5 kms east of Oxley (not listed on NHIC EO Summary), Town of Essex (formerly Colchester South Township). Last observation in 1985 by B.A. Ford. Species could not be refound in 2002 by G.M. Allen but entire habitat not investigated.

5.3 km east of Oxley, at the junction of County Roads 23 and 50 (not listed on NHIC EO Summary), Town of Essex (formerly Colchester South Township). Last observed by B.A. Ford in 1985 as "Single plant growing in ditch." Not refound in 2002 by G.M. Allen.

0.5 km south of West Pump, West Shore Road, Pelee Island (EO 003). First observation in 1959 by Armstrong, then in 1969 by R. Stuckey as "A few plants.", and subsequently by M.J. Oldham in 1983 as "Ditch, scarce". Not observed since and believed extirpated.

Population #30 (EO 004) - Middle Point Woods, Pelee Island. Observed in 1985 by M.J. Oldham with, "Ten to twenty clumps in low wet opening of woods." [none present when observed by Woodliffe in Aug. 2003].

Population #29 (EO 005) – Lighthouse Point, Pelee Island. Last observed by M.J. Oldham in 1988 as "uncommon." [none seen by Woodliffe in Aug. 2003]

Norfolk County

Turkey Point Marsh, Delhi Township (EO 021). Not recorded since 1943 when collected by T. Norris, and not found despite intensive coverage by J. Bowles in the late 1980s as part of a detailed ANSI inventory. Considered extirpated.

Bluff Point, Long Point National Wildlife Area, Norfolk Township (EO 018). Last recorded in 1981 by P.M. Catling near tip (on north side) of Long Point. This population has not been observed in recent years and is believed extirpated (Ashley, pers. comm. 2002). Photo by P. Mohr at MICH. Publicly owned by Environment Canada.

Municipality of Chatham-Kent

Municipality of Chatham-Kent/Essex County Line, Lake St. Clair (EO 017). Last observed in 1956 by L.L. Stock. This station was searched in 2002 by G.M. Allen by scanning with binoculars from the south side of the Thames River at Lighthouse Cove. No *Hibiscus* was located, and the entire marsh viewed was occupied by *Phragmites*, two cabins, manicured lawns, and steel retaining walls. Considered extirpated.

Mitchell's Bay, Lake St. Clair, Dover Township (EO 029). Last observed in 1987 by M.J. Oldham with "Single vegetative plant on disturbed beach at park". Publicly owned as a municipal park and believed to no longer be present (Haggeman, pers. comm. 2003).

Lambton County

Grand Trunk Railway at Sarnia, Lake St. Clair. Last observed in 1894 by J. Dearness. Ford noted in 1986 that "The development of wetland habitat for industrial use has probably extirpated *H. moscheutos* from this station."

Grassy Bend Islands, Walpole Island First Nation (EO 056). Last observed in 1950 by J.K. Shields with no abundance information available. This station was not searched in 2002 by G.M. Allen but it has not been observed in over 50 years and is probably extirpated.

Niagara RM

Along the Welland Canal, City of Welland (EO 033). Last recorded in 1952 by Anderson with "a few plants" noted. Ford noted in 1985 that this population could not be relocated by him and that development of wetland habitat for industrial and recreational use had probably extirpated the *Hibiscus* from the site. Not resurveyed by G.M. Allen in 2002.

Niagara-On-The-Lake, Town of Niagara-On-The-Lake. Last observed in 1910 by Scott. Available information very vague. Ford noted in 1985 that this population could not be relocated by him and that development of wetland habitat for industrial and recreational use had probably extirpated the *Hibiscus* from the site. Not resurveyed by G.M. Allen in 2002.

Queenston, Town of Niagara-On-The-Lake. Last recorded in 1899 by Scott. Available information very vague. Ford noted in 1985 that this population could not be relocated by him and that development of wetland habitat for industrial and recreational

use had probably extirpated the *Hibiscus* from the site. Not resurveyed by G.M. Allen in 2002.

Miller Creek, Bertie Township. Not recorded since 1968 when observed by L.C. Sherk as "Large patch 20 by 10 feet." Location data obscure. Not resurveyed by G.M. Allen in 2002.

Historical Populations of Unknown Status

Municipality of Chatham-Kent

Mitchell's Bay, Lake St. Clair, Dover Township, 4 km SSW of Mitchell Bay (EO 027). Last observed in1950 by J.K. Shields. Good shoreline marsh habitat certainly exists in this location between those stations at Patrick's Cove and St. Luke's Bay, and the species is believed to still be in the vicinity (Haggeman, pers. comm 2003).

Potential Sites for Investigation

The Canadian range of *H. moscheutos* has been intensively surveyed by many botanists. Due to the conspicuous nature of this plant when it is in flower, the localities cited in this report probably represent a high proportion of this species' actual occurrence in Canada. Continued searching, however, may reveal new populations within its known range. Two potentially new stations are:

Possible site in Malden Township 2 km southeast of Amherstburg, at very north end of Big Creek Marsh, suggested by G.E. Waldron, was investigated 11 August 2002 by G.M. Allen but no *Hibiscus* was observed by scanning with binoculars to the north and south. Marsh habitat is available north and south of the bridge over Big Creek, but is very choked with *Phragmites*.

The interior marshes of Big Creek (Amherstburg) certainly warrant investigation by boat for stands of *Hibiscus*. This expansive wetland was only surveyed by road for the update. Good habitat with few stations ever documented exists between County Road 20 and Holiday Beach Conservation Area.

Also in 2002 G.M. Allen surveyed unsuccessfully in Anderdon Township 2 km east of River Canard at the bridge over the Canard River. Once again, every available marsh habitat scanned by binoculars looking to the north and south along the river was occupied by *Phragmites*.

LIMITING FACTORS AND THREATS

The greatest threats to the survival of *Hibiscus moscheutos* in Canada derive from two sources – the continued degradation of its coastal wetland habitat, and the invasion of this habitat by invasive species, in particular *Phragmites australis*. Although large

populations are currently being 'protected' in Ontario, as yet there is no successful control of *Phragmites* at any wetland in the province, and the threat which this highly invasive grass ultimately poses to *Hibiscus* is unknown. Observations by the senior author at many of the *Hibiscus* stations in 2002 would suggest the prognosis is not good.

Due to the showy appearance of this plant, private landowners are aware of its presence on their property but are generally unaware of its significance.

1) Habitat Degradation

As mentioned previously, *Hibiscus* appears to do best under a management regime of controlled water levels with partial yearly drawdowns (Farney and Bookhout, 1982). Eleven of the Ontario populations occur in dyked marshes, the best examples being those at sites # 8 and 39. This artificially maintained regime serves to greatly reduce the competition from not only encroaching shrubs and trees, but also from *Phragmites*. In pre-settlement southern Ontario, fires and fluctuating water levels would have in large part served to control the succession of the open meadow marshes. Today there are few examples of prescribed burning in our coastal marshes, the annual management of the Walpole marshes being one of the exceptions. The majority of the *Hibiscus* stations are thus subjected to a gradual decline in quality of habitat, the result of continuing nutrient loading, successional change, and general lack of natural disturbance. The resulting proliferation of *Phragmites* and *Typha* X *glauca* is a symptom of this degradation, as these species exploit the compromised environment.

During the 2002 field surveys for the update, habitat degradation was noted at several sites. The station at site # 16 on the south shore of Lake St. Clair, has only ever been documented as consisting of a couple of plants, but it really has nowhere to expand to. About 50% of the habitat is occupied by wooden docks, and mowed lawns are maintained right up to the edge of the two extant plants. The *Hibiscus* actually grows in fill deposited along the edge of a creek. The shore and mouth of Pike Creek are intensely developed with the high-end homes of Pilot's Cove Estates on the west tip. Concrete and steel retaining walls, a marina, and manicured lawns and gardens, preclude any coastal wetland habitat greater than the tiny remnant occupied by the two plants of *Hibiscus*. Proximal to the population, *Phragmites* dominates along the banks of the backwater stretch of the creek. Impacts from adjacent homes directly on *Hibiscus* stands were noted at sites # 17 and 27, where lawn waste and brush were observed as being dumped onto the *Hibiscus* plants. Several populations are in very close proximity to agricultural operations. The two largest populations, sites # 8 and 39, both face the lake, but are surrounded on the other three sides by cultivated land. At site #12, for the most part, the *Hibiscus* plants are in remnant wetlands immediately downslope from intensively farmed soybean fields, and are thus prone to sediment and nutrient loading, and pesticide and herbicide drift. Several stations are subjected to roadside maintenance, such as at site # 20, where a 3 metre swath was observed as being freshly cut into the *Hibiscus* stand by the municipal roads crew. Similar maintenance would occur along the railway verges, and it is difficult to say what the net impacts are, since such cutting does at least serve to retain the open character of the habitat. With

the receding Great Lakes water levels over the past few years, Cottonwood (*Populus deltoides*) was observed as succeeding into several of the coastal stations, as at site # 23, where it is actually invading a solid sea of *Phragmites*.

2) Shoreline Development

A few of the historical *Hibiscus* stations are believed to have been extirpated as a result of the development of coastal wetland for industrial or recreational use, e.g. Sarnia, Niagara-on-the-Lake, Queenston, and City of Welland. Ford indicated the continuation of such problems in the 1985 report, citing examples of marina development on the Canard River close to the existing population of *H. moscheutos;* wetland loss due to housing development at site # 7; and the longstanding reclamation of wetland which continued into the 1980s at site # 38, which threatened to eliminate the population of *H. moscheutos* at that site. This outright loss of wetland habitat is probably not as pronounced today as it was 20 years ago, at least in part due to improved legislative protection for wetlands via the Provincial Policy Statement and perhaps an enlightened attitude toward wetlands by owners, and of the benefits they accrue.

Hibiscus populations are still impacted by shoreline development, as observed by the senior author in 2002. For example, the south shore of Lake St. Clair is undergoing rapid development of subdivisions. At site # 17 sub-populations have been lost in the urbanizing landscape, and the shoreline through this area is now entirely developed with estate homes, manicured lawns, docks, and retaining walls. The only habitat exists along the railway rights-of-way. Other *Hibiscus* stations are being impacted by adjacent development of housing units. The population at site # 25 was lost when the railway verges were 'improved' as part of the general upgrade of that site during the development of the abutting subdivision. At site # 15, a sewer line constructed in a berm, dissects the coastal wetland, and compromises the hydrology. A 149-lot single family subdivision is planned, which will surround the wetland, and could further imapct this already degraded habitat. Similarly, several lots immediately adjacent to site # 7 are approved for development, where presently the *Hibiscus* is only subject to lawn waste being dumped at the edge of mowed lawns of vacant lots. Shoreline development has also been on the rise along the Detroit River, and this results in virtually a continuous steel retaining wall of a couple of metres in height, with no transitional edge for *Hibiscus*. *Phragmites* tends to occupy what little habitat remains along the developed shore of the river.

The only case of direct impact from agricultural operations observed in 2002 was at site # 20 where several clumps of *Hibiscus* were noted as growing in the open, moist edge of a soybean field.

3) Competition from Invasive Species

The most significant change with respect to invasive species in the fifteen year span since the original status report has been with the Common Reed (*Phragmites australis*). This species has undergone a dramatic increase in wetlands in Essex

County in particular (Pratt, pers. comm, 2003), at Long Point (Wilcox and Petrie, undated c), and throughout the lower Great Lakes (Haggeman, pers comm. 1999, in Wilcox and Petrie, undated b). A number of *Hibiscus* stations are dominated by *Phragmites*, including those on the Canard River, the Detroit River, the south shore of Lake St. Clair, and the Big Creek (Amherstburg) system. Some stations are seemingly bordering on exclusivity by this grass, for example at sites # 21 and 23. From the almost total dominance of *Phragmites* observed by the senior author at numerous stations in 2002, it is believed the species has probably resulted in the extirpation of populations or subpopulations at the following stations: Canard River, Fox Creek, Fighting Island, LaSalle Marina, Belle River, and the mouth of the Thames River.

In a study at Long Point NWA (Wilcox and Petrie, undated c), researchers have detected a moderate increase in *Phragmites* cover between 1985 (4ha) and 1995 (18ha), and an exponential increase between 1995 and 1999, when it expanded to 142 hectares, or 1% of the entire study area. Perhaps most critical to the survival of *Hibiscus* was the finding that the primary communities that were replaced by *Phragmites* were meadow marsh (33%) and *Typha* marsh (32%). The study concluded that *Phragmites* abundance is negatively correlated with Lake Erie water depth, and positively correlated with ambient temperature, causing the researchers to suggest that, if global warming predictions are realized, *Phragmites* will continue to expand on the lower Great Lakes.

Phragmites australis is reported to be the most widely distributed flowering plant in the world (Tucker, 1990, in Rice *at al.* 2000). It has been so successful in its 30-year spread along the Atlantic Coast of the United States that it is now considered a noxious weed (Rice *et al.*, 2000; Tucker, 1990; Chambers *et al.*, 1999; and in Wilcox and Petrie, undated c) and there is wide agreement that it should be controlled (Phragmites Bio-control Workshop, 1999; in Wilcox and Petrie, undated c). Of 22 US National Wildlife Refuges surveyed, 18 attribute a great deal of time and resources annually to controlling *Phragmites* (Phragmites Bio-control Workshop, 1999; in Wilcox and Petrie, undated c).

One of the characteristics of *Phragmites* likely impacting *Hibiscus*, is that its growth pattern produces homogenous clones with up to 200 culms/m2 (Tewksbury *et al.*, 2002). Its dead canes remain standing for 3 to 4 years before becoming part of the slowly decomposing litter layer. The sheer biomass of these dead canes may exceed that of living shoots, resulting in thick mats which even new *Phragmites* shoots can not penetrate (Haslam, 1971; in Wilcox and Petrie, undated a). Another, as alluded to above, is that invasions typically follow disturbances or stresses such as an altered hydrologic regime, dredging, increased nutrient availability, or development (Wilcox and Petrie, undated a, Rice *et al.*, 2000)). Such competitive advantages have seen the replacement of diverse wetland vegetation by *Phragmites* monocultures and decreases in plant diversity and alterations in nutrient cycling and hydrologic regimes (Marks *et al.*, 1994; and Chambers, 1997, in Tewksbury *et al.*, 2002).

The authors are unaware of any sites in Ontario where effective control has been implemented for *Phragmites*, and none of the *Hibiscus* stations are being monitored for

impacts from *Phragmites*. Biological controls are not yet available in North America (Wilcox and Petrie, undated b).

The second-most problematic invasive species impacting *Hibiscus* is Hybrid Cattail (*Typha* X *glauca*). It is dominant or co-dominant (invariably with *Phragmites*) at a number of the *Hibiscus* stations, for example throughout the Big Creek (Amherstburg) wetland, Point Pelee, and the wetlands around Lake St. Clair. At site # 37 Haggeman (pers. comm. 2002) has observed that the hybrid cattail has been effectively out-competing the *Hibiscus* over the last few years. Interestingly, *Typha* X *glauca* is quite common in the marshes at both site # 8 and site # 39 where *Phragmites* appears to be excluded. *Phragmites* occurs immediately outside the dyke walls at site # 39 in the coastal marsh open to the lake. As with the *Phragmites*, the authors are unaware of any proven control sites for *Typha* X *glauca* in Ontario, and we are not aware of any monitoring of the effects of *Typha* X *glauca* on populations of *Hibiscus*.

Although purple loosestrife (*Lythrum salicaria*) is certainly present at a number of the *Hibiscus* stations, the threat which it posed to *Hibiscus* through the 1980s, as noted by Ford in the original status report, has been downgraded. Whether this is due to a natural levelling off of its own exponential rise, or to biological controls, is unknown. At site # 8, it was noted by Allen in 2002 that a large stand of *Lythrum* in the northwest corner had died out, and *Impatiens capensis* was moving into the standing dead colony.

Several other invasive species were noted within *Hibiscus* populations by Allen during 2002 field surveys, including flowering rush, *Butomus umbellatus,* (sites # 4, 8, 27); common thistle, *Cirsium vulgare,* (sites # 15, 27, 19); Scot's pine, *Pinus sylvestris,* (site # 25 Matchette Rd. sub-pop); teasel, *Dipsacus fullonum,* (site # 19), and black alder (*Alnus glutinosa*). The potential negative effects of these non-natives on *Hibiscus moscheutos* is unknown.

One other species undergoing a dramatic rise in its populations, this one indigenous, should be noted. Double-crested Cormorants now occur in extremely high numbers in southern Ontario, where they can overlap directly with *Hibiscus*, probably resulting in negative effects on populations. *Hibiscus* populations potentially affected are those in the western basin of Lake Erie: sites # 26, 29, 30, 32, 33, and 31. Again, no studies to monitor such impacts are known.

SPECIAL SIGNIFICANCE OF THE SPECIES

During the 1900s, *Hibiscus moscheutos* was investigated as a fiber source, particularly in New Jersey. Like ramie, the perennial plants could be cut annually, however the extracted fibre apparently lacked sufficient strength for commercial use. No food use is known, but the seeds of *H. moscheutos* are reported to be of use medicinally for their cordial, stomachic, nervine, pungent, demulcent, and emollient properties (Winters, 1970). The most important economic use the rose-mallows generally, is as ornamentals (Winters, 1970). Since the early 1900s, successful

hybridization of *H. moscheutos* with the progeny of *H. coccineus*, *H. laevis*, and *H. grandiflorus* has produced several widely-used F1 hybrids – notably Southern Belle and Dixie Belle. These hybrids are available as seed from catalogue companies and are appropriate for USDA zones 5 to 10. The hybrid found for years in the nursery trade as Meehan's Mallow Marvels, was obtained by crossing a hardy red-flowered hybrid of *H. coccineus X H. militaris* with *H. moscheutos* (Wise and Menzel, 1971; Bailey, 1949; Jury, 1978). Native plants are also valued as ornamentals and have been transplanted into gardens in Belle River, Walpole Island, Amherstburg, and Shrewsbury.

Cahoon and Stevenson (1986) studied rates of production, leaf grazing, and stem decomposition associated with *H. moscheutos* at a brackish marsh of Chesapeake Bay, where it dominates over one hectare, and contrasted this with other fresh and saltwater species. The decomposition rate of *Hibiscus* stem material was estimated to be on the order of 7 to 8 years, or up to five times slower than stems of other typical brackish marsh species (*Typha, Scirpus*, and *Phragmites*). *Hibiscus* stem tissue stands upright long after dying due to its high lignin content. Once it has fallen, it decomposes slowly due to lack of submergence, which may limit the development of fungal microflora and degadative enzyme production (Gessner, 1980, cited in Cahoon and Stevenson, 1986). They found that most of the net community productivity may end up accumulating in the sediment horizon in the *Hibiscus* marsh, with only *Scirpus fluviatilis* coming close to the abnormally high rates of accretion (>1cm/yr) found in *Hibiscus*. They hypothesized that *Hibiscus* differs from *Spartina* in salt marsh systems by nourishing a more robust grazing food chain and by not exporting significant quantities of detrital material to surrounding coastal waters. They suggested that the accumulation within *Hibiscus* marshes may be important in the Chesapeake region, where apparent sea level rise is 4 mm/year and some irregularly flooded marshes are eroding due to low rates of sediment accretion.

Hibiscus moscheutos can occur in fairly high numbers in the marshes of southwestern Ontario, where it contributes to their aesthetics. In association with *Typha* and *Scirpus* spp., rose-mallow may also play a role in shoreline stabilization and the creation of wildlife habitat.

EXISTING PROTECTION OR OTHER STATUS

Global Heritage Status Rank:

G5T5 Secure – Common, widespread, and abundant (although it may be rare in parts of its range, particularly on the periphery). Not vulnerable in most of its range. Typically with considerably more than 100 occurrences and more than 10,000 individuals (assigned 16 May 1984, NatureServe 2003).

National Heritage Status Rank (US):

N? Unranked – Nation or subnation rank not yet assessed (NatureServe 2003).

US & Canada State/Province Heritage Status Ranks:

S1 (Critically Imperiled) in Wisconsin
S2 (Imperiled) in Rhode Island; Kansas and California
S3 (Vulnerable) in Michigan
S3 (Vulnerable) in Ontario
S5 (Secure) in Delaware and New Jersey
S? (Unranked) in Kentucky; West Virginia and Utah
SU (Unrankable) in North Carolina
SR (Reported) in Alabama, Connecticut, Florida, Georgia, Illinois, Indiana, Kansas, Louisiana, Maryland, Massachusetts, Michigan, Mississippi, New York, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, and Virginia; (NatureServe 2003).

National Rank (Canada): N3 (Vulnerable in the nation either because rare and uncommon, or found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extirpation. Typically 21 to 100 occurrences or between 3,000 and 10,000 individuals (assigned 9 August 1993, NatureServe 2003).

Ontario Rank: S3 (Vulnerable in the province either because rare and uncommon, or found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extirpation. Typically 21 to 100 occurrences or between 3,000 and 10,000 individuals (assigned 14 September 1993, NHIC 2002).

- **OMNR Designation:** None
- **COSEWIC Designation:** Special Concern (April, 1987).
- **Ontario General Status:** Sensitive (assigned 19 April 2000, NHIC 2002)

TECHNICAL SUMMARY

Hibiscus moscheutos
Swamp Rose-mallow
Range of Occurrence in Canada: Ontario

Ketmie des marais

Extent and Area Information	
• *Extent of occurrence (EO)(km²)* (Based on GIS calculation of a polygon in which all points at outer limits of range are included)	22,000 km^2
• *Specify trend in EO*	Increasing
• *Are there extreme fluctuations in EO?*	No
• *Area of occupancy (AO) (km²)*	~9.5 km^2
• *Specify trend in AO*	Decline
• *Are there extreme fluctuations in AO?*	Unknown
• *Number of known or inferred current locations*	51
• *Specify trend in #*	Increase from 40 to 51(due mainly to increased search effort but 2 may be range extensions)
• *Are there extreme fluctuations in number of locations?*	No
• *Specify trend in area, extent or quality of habitat*	Declining
Population Information	
• *Generation time (average age of parents in the population)*	Several years
• *Number of mature individuals*	Estimated at thousands (but <10,000)
• *Total population trend:*	Unknown
• *% decline over the last/next 10 years or 3 generations.*	N/A
• *Are there extreme fluctuations in number of mature individuals?*	Likely not
• *Is the total population severely fragmented?*	Likely not since floating mats of plants are observed and seeds are dispersed by water
• *Specify trend in number of populations*	Seven of the 40 populations surveyed by Ford in 1985 have been extirpated
• *Are there extreme fluctuations in number of populations?*	No
List populations with number of mature individuals in each:	See table 1
Threats (actual or imminent threats to populations or habitats) 1) Habitat degradation 2) Shoreline development 3) Competition from invasive species	
Rescue Effect (immigration from an outside source)	
• *Status of outside population(s)?* **USA:** Exists in 27 US states S1 in Wisconsin; S2 in Rhode Island; S3 in Michigan	
• *Is immigration known or possible?*	Yes
• *Would immigrants be adapted to survive in Canada?*	Yes
• *Is there sufficient habitat for immigrants in Canada?*	Yes
• ***Is rescue from outside populations likely?***	**Yes**
Quantitative Analysis	**N/A**
Current Status **COSEWIC: Special Concern (1987, 2004)**	

Sources of information: Fieldwork conducted in 2002 and slightly updated with Aug.- Sept. 2003 field data from A. Woodliffe.

- The Extent of Occurrence was calculated for the Ontario stations by joining, using GIS, the centroids of the outermost stations, i.e. Walpole Island, Sandbanks, and Main Duck Island, and subtracting the open water of Lakes Ontario and Erie captured within the polygon.

- The Area of Occupancy was calculated for the stations at Willowood West and St. Lukes Marsh by using a dot grid overlaid on a copy of 1998 infrared photos of the sites, knowing the approximate extent of the *Hibiscus* from the 2002 site inspections. For the remainder of the 50 extant stations, the Area of Occurrence was estimated individually for each population, from the site inspections by the senior author in 2002 and from the information available from other observers.

Status and Reasons for Designation

Status: Special Concern	**Alpha-numeric code:** Met criterion for Threatened, D2, but designated Special Concern because it is relatively widespread, found in protected areas, and there is potential for rescue effect.
Reasons for Designation: A robust, perennial herb of shoreline marshes of the Great Lakes present in Ontario at many localities, in very small areas, and generally in low numbers. The total Canadian population is estimated to consist of fewer than 10,000 plants with some, including two of the largest populations, in protected sites. The species has been subjected historically to habitat loss and several populations have been lost recently. Populations are also at risk from habitat degradation and impact due especially to invasive exotic plants. Evidence of the spread of plants through rafting of floating clumps indicates that recolonization of extirpated sites may be possible.	
Applicability of Criteria **Criterion A** (Declining Total Population: Not met (Insufficient information) **Criterion B** (Small Distribution, and Decline or Fluctuation): Not met. The species has a relatively small area of occupancy (<10 km^2), is present at many sites, but these are not deemed to be highly fragmented due to the floating seeds and rafting of uprooted plants; no extreme fluctuations occur in population sizes.) **Criterion C** (Small Total Population Size and Decline): Not met. Population size is estimated to consist of < 10,000 plants, meeting the threshold for threatened and continuing decline in mature individuals is suspected due to the spread of invasive exotics but no firm data has been documented and at least two populations have > 1,000 plants.) **Criterion D** (Very Small Population or Restricted Distribution): Meets Threatened D2 based on the small area of occupancy and the continued shoreline development at many sites and the rapid expansion and impact of an exotic grass that has had great and increasing impacts in wetlands. Both factors have resulted in recent losses to entire or partial populations. Special Concern is recommended, however, due to the presence of many localities in a series of provincially and federally protected sites such as parks, conservation areas and provincially significant wetlands (including two of the largest populations). Rescue is also possible due to the spread of floating seeds and rafting plants. **Criterion E** (Quantitative Analysis): No quantitative analysis available.	

ACKNOWLEDGEMENTS AND AUTHORITIES CONTACTED

Given the time constraints for this report, it was impossible for the authors to visit all of the original sites. It therefore greatly improved the quality of this update to have those botanists familiar with specific sites for *H. moscheutos* give so freely of their information. The authors thank the following people for supplying information critical to updating this species: Yvette Bree, who specifically counted plants and characterized the habitat of the *Hibiscus* at site # 51 for this update; John Haggeman, who provided his data on *Hibiscus* for several of the Lake St. Clair stations, and guided the senior author to key sites in 2002; Mike Oldham, who surveyed the populations at sites # 26, and 42, including GPSing the sub-populations at the latter; Allen Woodliffe, who provided his data for all the stations in the vicinity of Rondeau, the Pelee Island stations, and for sites # 2 and 5; Gerry Waldron, who provided his data for several stations in Essex County, and guided the senior author to key sites in 2002. Several other people contributed information on their observations of *Hibiscus* populations. They are: Paul Ashley, Madeline Austen, Dr. Jane Bowles, Sandy Dobbyn, Rob Eberly, Albert Garofalo, Donald Kirk, Dan Lebedyk, George Meyers, and Melinda Thompson. Don Bucholtz, Superintendent at Sandbanks Provincial Park, ensured that current data on site # 51 was provided to the senior author, as per an E-mail request. Mary Gartshore kindly made the contact for the senior author with Rob Eberly and Albert Garofalo. Ian Jean accompanied the senior author to inspections of sites # 1, 50, and the Hasting Road stations in 2002. Vicki McKay, Species-at-Risk Biologist at Point Pelee National Park kept an eye out for first flowering of *Hibiscus* and alerted the senior author to permit proper scheduling of field time.

Kelly Ramster and Mike Oldham of the NHIC also provided element occurrence data from the NHIC database for every known station, as well as conservation status ranks. Ilo-Katryn Maimets, York University Library, was extremely helpful in accessing the York University and University of Toronto databases to search for papers on Swamp rose-mallow and in suggesting 'good sites' in general to search. Paul Jurjans, GIS Specialist at Midhurst MNR, graciously converted a number of UTMs in NAD 83 to NAD 27. Laurie Maynard, Canadian Wildlife Service offered some very helpful suggestions on the report, and supplied the senior author with additional current papers on *Phragmites australis*. Topographical maps were loaned to the senior author by Mary Gartshore and Peter Carson for the Niagara stations, and Allen Woodliffe provided copies of the infrared photos for sites # 8 and 39 to permit calculations of the areas of occurrence, and provided the pertinent pages on *Hibiscus* from the Kamstra study of the Pelee Islands. Dr. Erich Haber is thanked for establishing the contract and for providing COSEWIC report formats and criteria. Erich also scanned the maps and slides for the report, and incorporated changes in the various drafts.

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six-day road trip to undertake fieldwork for this report made the whole project worth doing.

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Authorities contacted

P. Ashley. 2002-2003. Paul is the Wildlife Area Manager for the Big Creek and Long Point National Wildlife Areas, Canadian Wildlife Service, Environment Canada. Paul provided information on all of the stations in the vicinity of Long Point.

J. Bowles. 2002-2003. Jane is a professor of botany at the University of Western Ontario, a consulting biologist, and an expert on the flora of southwestern Ontario. 22154 Fairview Road, R.R #3, Thorndale, Ontario N0M 2P0. Jane provided information and GPS coordinates for *Hibiscus* from her 2002 field surveys at Hahn Marsh.

Y. Bree. 2002. Yvette is the Park Naturalist at Sandbanks Provincial Park. She provided detailed data from her 2002 inspection of the *Hibiscus* station in Sandbanks.

S. Dobbyn. 2002-2003. Sandy is the Park Naturalist at Rondeau Provincial Park. He provided the summary information from previous field surveys on *Hibiscus* at Rondeau.

R. Eberly. 2002. Rob is a member of the Bert Miller Fort Erie Nature Club and an expert on the flora of the Niagara Region.

A. Garofalo. 2002-2003. Albert is an expert on the flora of the Niagara Region. He provided information from his 2002 field inspection of the Lake Gibson station.

J. Haggeman. 2002-2003. John is the Wildlife Area Manager for the St. Clair National Wildlife Area, Bear Creek Unit, Canadian Wildlife Service, Environment Canada. He provided information on the several stations in the Municipality of Chatham-Kent section of Lake St. Clair and guided the senior author to the key sites during a field day in August 2002.

D. Kirk. 2002. Donald is the Natural Heritage Ecologist with Guelph District of the Ontario Ministry of Natural Resources. He is an expert on the flora of southwestern Ontario. He was able to direct the senior author to the appropriate people for information on the Gibson Lake station.

D. Lebedyk. 2002. Dan is the Conservation Biologist for the Essex Region Conservation Authority, 360 Fairview Ave. West, Essex, Ontario. N8M 1Y6. Tel: (519) 776-5209 ext. 409. He provided information on all known stations in Essex County from ERCA's Environmentally Significant Areas database.

G. Meyers. 2002. George is an expert on the flora of the Niagara Region. 7 Bedford Park Drive, Grimsby, Ontario. He provided information on the Jordan Harbour, Port Weller, and Lake Gibson stations.

M.J. Oldham. 2002-2003. Botanist/Herpetologist. Natural Heritage Information Centre, Ontario Ministry of Natural Resources, 300 Water Street, 2nd floor, North Tower, P.O. Box 7000, Peterborough, Ontario K9J 8M5. Mike specifically recorded the populations of *Hibiscus* at Point Pelee and Rondeau, gathered during his family

vacation, and provided the information for these, including GPS locations of the latter.

P.D. Pratt. 2002-2003. Paul is the Chief Naturalist for the City of Windsor and an expert on the flora of southwestern Ontario. City of Windsor, Dept. of Parks & Recreation, 2450 McDougall Road, Windsor, Ontario N8X 3N6.

Dr. A.A. Reznicek. 2002-2003. Professor and Curator of the Herbarium. University of Michigan, Ann Arbor, Michigan 48109. Tony was contacted during the preparation of the original report.

M. Thompson. 2002. Melinda is Species-at-Risk Biologist with Guelph District of the Ministry of Natural Resources. She provided information on her inspection of the Lake Gibson station.

G.E. Waldron. 2002-2003. Gerry is a private Consulting Ecologist and an expert on the flora of Essex County. R.R. #1, Amherstburg, Ontario N9V 2Y7. Gerry drew several stations to the senior author's attention, and guided him to a few of these during a field day in 2002.

P. Allen Woodliffe. 2002-2003. Allen is an Ecologist with the Ontario Ministry of Natural Resources, Chatham, and is an expert on the flora of southwestern Ontario. Allen provided data on a number of the stations, in particular those at Rondeau and Shrewsbury, those on Pelee and east Sister Islands, and the St. Thomas Waterworks.

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BIOGRAPHICAL SUMMARY OF REPORT WRITERS

Gary Allen received an Honours B.E.S. in 1979 and an M.A. in Regional Planning and Resource Development in 1984, both from the University of Waterloo. For the past 20 years he has worked for the Ministry of Natural Resources, always in the Natural Heritage Program, with postings in Toronto, Chatham, Richmond Hill, Simcoe, and currently, Midhurst. His responsibilities as Natural Areas Ecologist in Midhurst District are primarily Areas of Natural and Scientific Interest (ANSIs), Species at Risk, and Wetlands, and he is a member of the Provincial Wetlands Committee (WETT), the Lake Huron Coastal Dune Grasslands Recovery Team, and the Eastern Fox Snake & Eastern Hognose Snake Recovery Team. He has prepared COSEWIC status reports on *Liatris spicata* (1988), *Liparis liliifolia* (1986), *Aristida basiramea* (2003), and an update on *Liatris spicata* (2001).

Bruce Ford is an Associate Professor in the Department of Botany, University of Manitoba and curator of the University of Manitoba Herbarium. Bruce's primary research interest is the taxonomy and evolution of the genus *Carex*. *Carex*, with about 2,000 species, is the largest genus in the Cyperaceae and one of the most widespread and ecologically important genera of vascular plants. In his research Bruce employs a multidisciplinary approach, combining evidence from micro- and macromorphology, isozyme genetic divergence, DNA sequence data, ecological studies, and phytogeography in order to gain a proper understanding of systematic relationships. He has published a variety of scientific papers including species treatments for the Atlas of the Rare Vascular Plants of Ontario and the Flora of North America. Bruce serves as a scientific advisor for the Flora of North America Project and is a member of the vascular plant subcommittee of COSEWIC.

COLLECTIONS EXAMINED AND FIELDWORK CONDUCTED

All relevant herbaria were searched for specimens of *Hibiscus moscheutos* by Cathy Keddy for the Atlas of the Rare Vascular Plants of Ontario. No herbaria collections were examined for this status update, as label data has been transcribed into tabular form as part of the Atlas of Rare Vascular Plants of Ontario Atlas Project, as well as various other efforts. This, and other information, was accessed using the individual element occurrence reports for *Hibiscus moscheutos*, provided by the NHIC.

Field studies were carried out for the original report by B.A. Ford from August 5 to 31, 1985. During this time information on associate species, population size, and general vigour of the plants was gathered. In addition, soil samples were obtained from the upper 10 cm at 10 stations. Fieldwork for this update was conducted by G.M. Allen on August 11th to 16th 2002. Field time was also provided toward the verification of populations for this update at the Rondeau and Point Pelee sites by M.J. Oldham, and at Sandbanks by Yvette Bree.

Specimens collected during the course of the original study are deposited at the herbarium of Erindale College, University of Toronto (TRTE).